Radiography used to image thermal explosions

October 9, 2012

Researchers have gained an understanding of the mechanism of thermal explosions and have created a model capturing the stages of the explosion. Proton radiography (pRad) at LANSCE imaged thermal explosions at high speeds to provide a real-time look at how an explosion unfolds and releases its energy. Specifically, it is important to know the range of temperature over which ignition may occur and the subsequent power of the explosion. Scientists have developed triggering techniques that synchronize the thermal ignition of the explosive with a radiographic source, making these studies possible.

A "tabletop" dynamic radiography experiment

In related work, **Bryan Henson** and **Laura Smilowitz** of LANL's Physical Chemistry and Applied Spectroscopy group have created a "tabletop" dynamic radiography experiment. The table-sized X-ray imaging apparatus performs X-ray imaging of sub-sonic dynamic events, such as thermal explosions, on a routine basis. The small-scale aspect allows many experiments to be performed. This approach provides a means to optimize experiments planned for larger radiographic facilities such as proton radiography.

Importance of the work

Dynamic radiography of explosives allows researchers to measure many phenomena involved in thermal explosions. Consequently, researchers have gained a better understanding of the mechanism of the explosion and have created a model that captures both the gas-phase convection and subsonic solid-state combustion. Understanding the thermal response of energetic materials to heating is a critical aspect of engineering and using these materials properly. The combination of tabletop dynamic radiography and proton radiography provides the information needed to predict thermal explosions in high explosives.

Two papers in the *Journal of Applied Physics* describe the proton radiography research. Coauthors include **L. Smilowitz, B. F. Henson, B. W. Asay**, **A. Saunders, C. L. Morris, F. Mariam, G. Hogan, M. M. Murray, C. Espinoza**, **F. E. Merrill, K. Kwiatkowski, P. Nedrow, G. Grim**, **W. McNeil, P. Rightley** and **M. Marr-Lyon**; and former Lab employees J. J. Romero, C. L. Schwartz, T. N. Thompson and J. Bainbridge. The NNSA Science Campaigns 1 and 2, the Surety Program, and the Joint

Munitions Program administered by the DOE and Department of Defense funded the research. The work supports the Lab’s Nuclear Deterrence and Global Security mission areas and the Materials for the Future and Science of Signatures science pillars.

Los Alamos National Laboratory www.lanl.gov (505) 667-7000 Los Alamos, NM

Managed by Triad National Security, LLC for the U.S Department of Energy's NNSA